

Geothermal Energy

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- Geothermal energy is defined as energy derived from the natural heat of the earth contained in hot rocks, hot water, hot brines or steam.



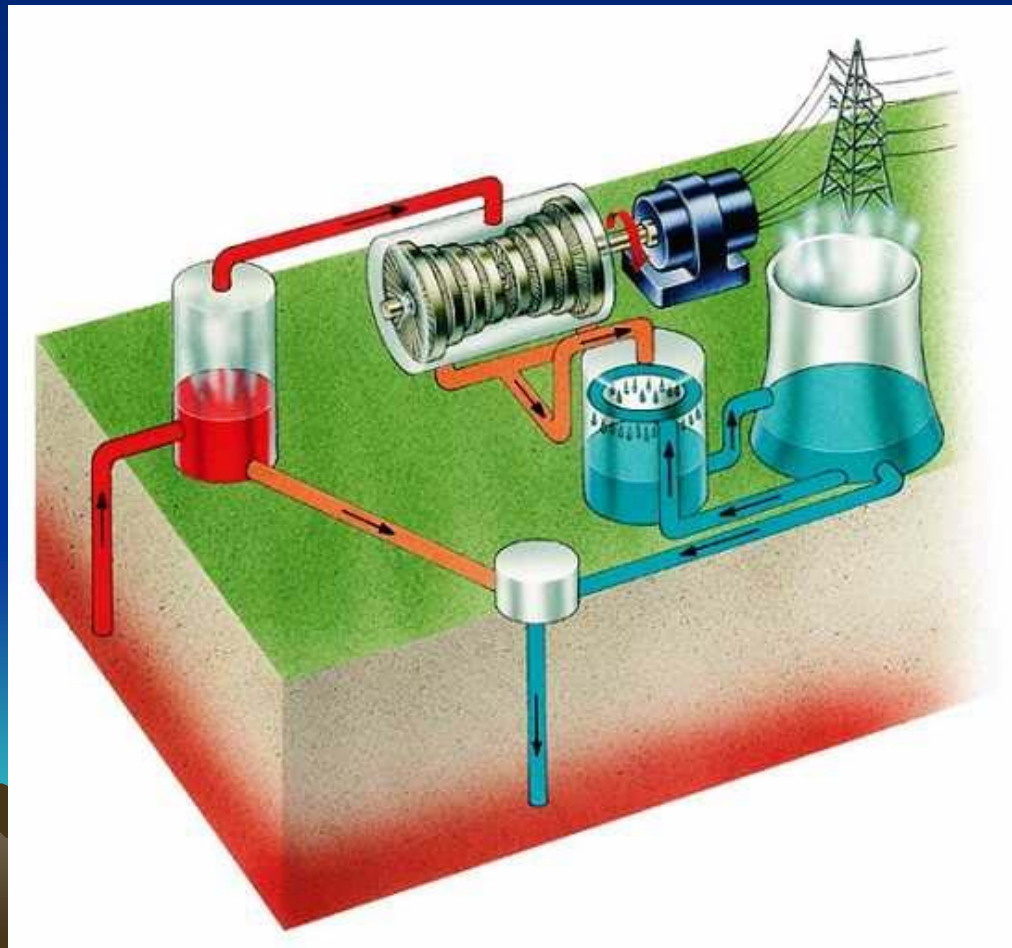
Methods of Geothermal Energy Capture

- Hydrothermal
- Deep Geothermal systems
- Geothermal Heat Pumps



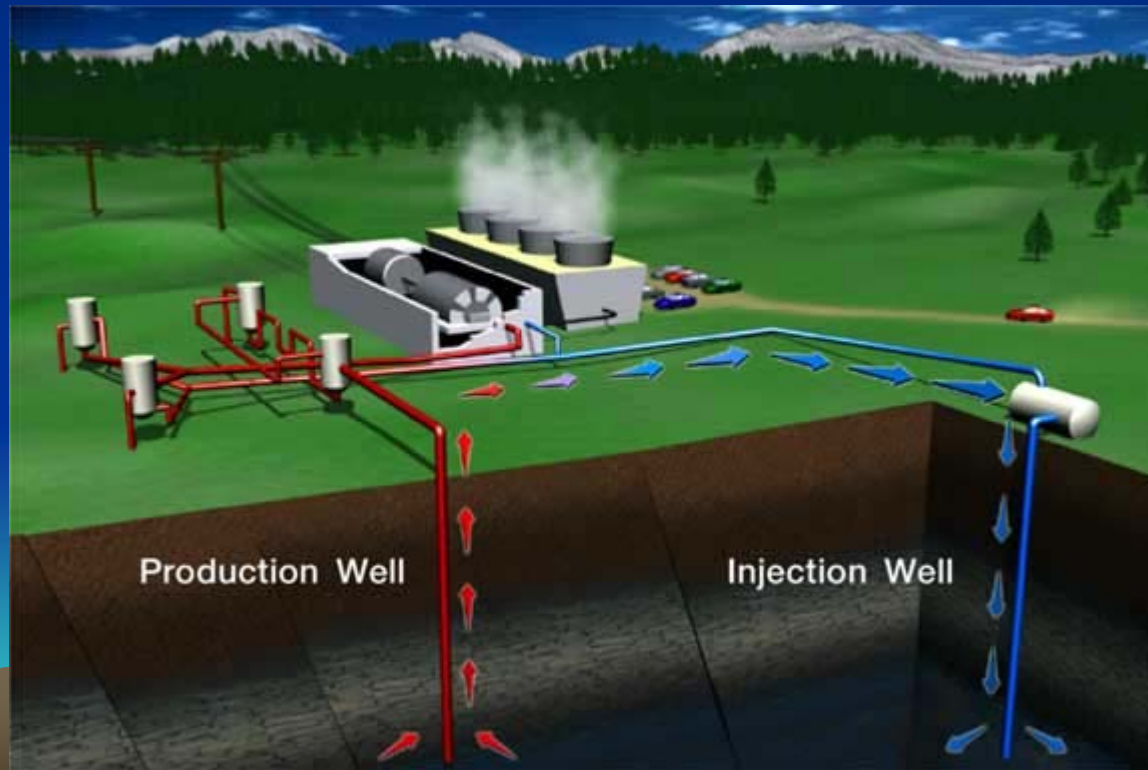
Hydrothermal Energy

Hydrothermal is the traditional commercial geothermal source. Hydrothermal uses hot water or steam directed to a steam turbine either on an indirect or direct basis.



Deep Geothermal Systems

Electricity is generated by pumping high pressure water down a borehole (injection well) into the heat zone. The water travels through fractures in the rock, capturing the heat of the rock until it is forced out of a second borehole as very hot water, which is converted into electricity using a steam turbine.



Geothermal Heat Pumps

- A geothermal heat pump is a heat pump that uses the earth's thermal capacity as an energy source to add heat to a system or as an energy sink to cool a system.



Types of Geothermal Heat Pumps

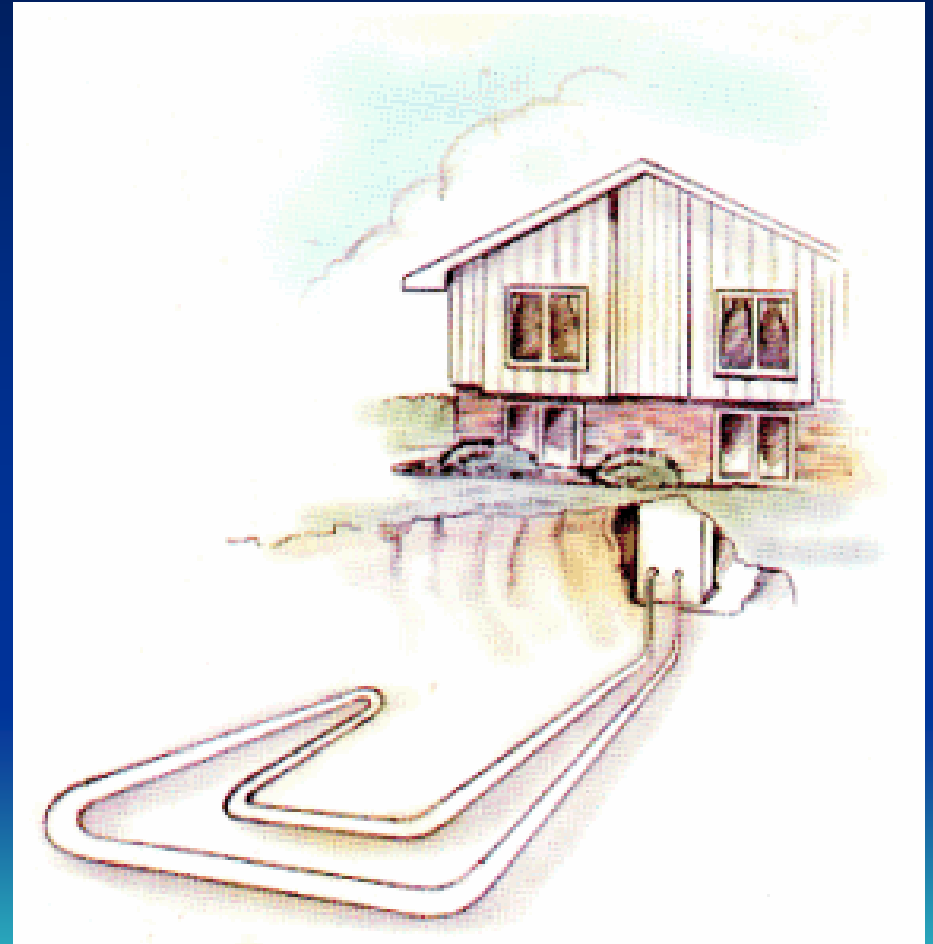
- Ground-coupled heat pumps
 - Vertical closed-loop
 - Horizontal closed-loop
- Ground water heat pumps
- Hybrid heat pumps



Ground-Coupled Heat Pump

Horizontal Closed-Loop

In a horizontal closed-loop ground heat exchanger, a water/antifreeze mixture is circulated through sealed pipe loops buried horizontally, about six feet underground. During cold weather, the pipe loops absorb heat from the earth and deliver it to the heat pump located in the house. The heat pump transfers heat from the loop to warm the air that is circulated throughout the house by ductwork.



Ground-Coupled Heat Pump

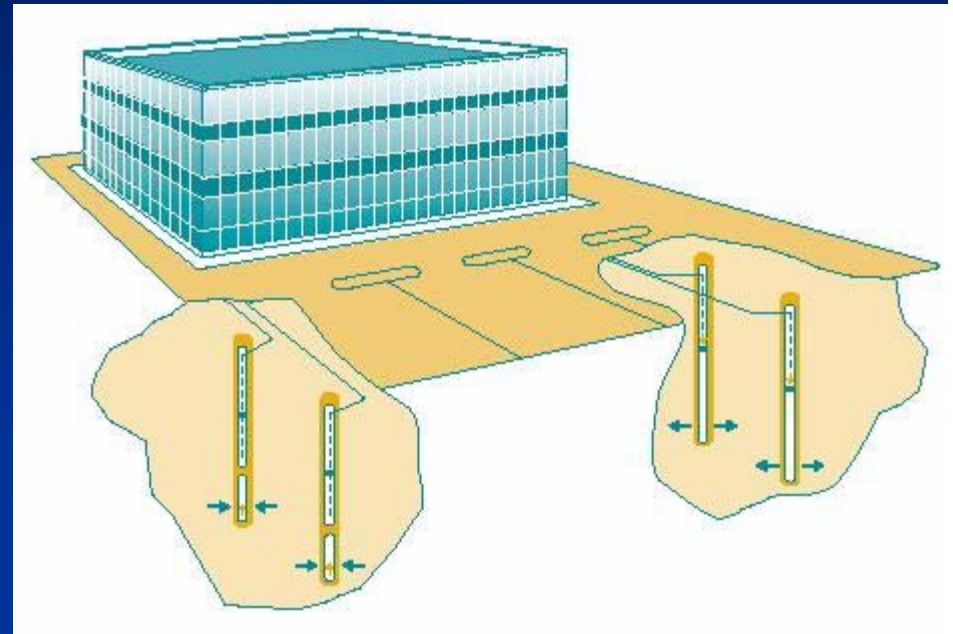
Vertical Closed-Loop

In a vertical closed-loop ground heat exchanger, a water/antifreeze mixture is circulated through sealed pipe loops buried in vertical bore holes. The bore holes are typically 150 to 200 feet deep. Heat is transferred by the heat pump system, from the ground during the winter and to the ground during the summer.

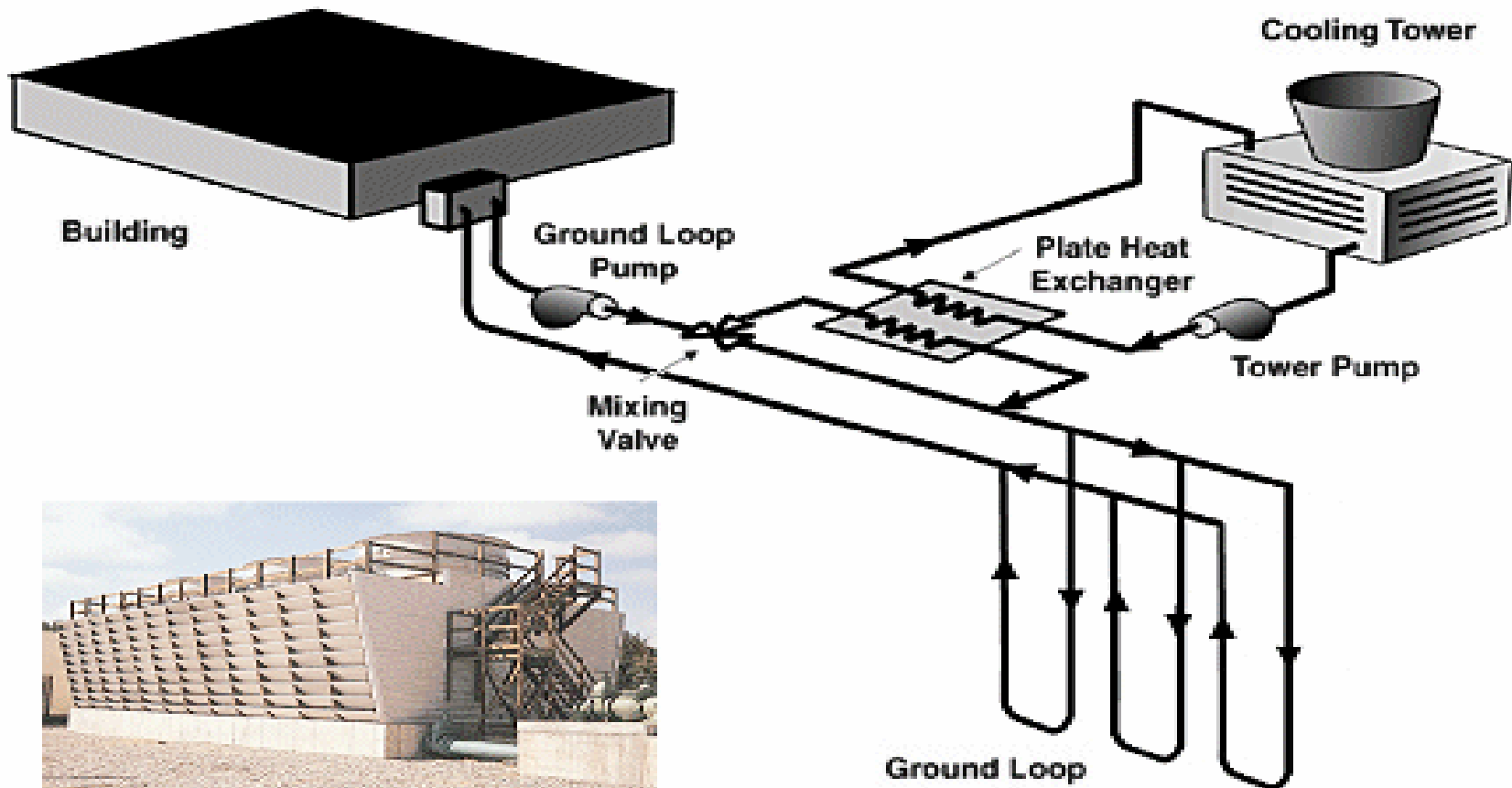


Ground Water Heat Pump

- A GWHP earth connection consists simply of water wells where ground water from an aquifer is pumped directly from the well to the building and returned to the aquifer by another well.



Hybrid Heat pump



Advantages of GHP System

- Savings
- Conservation
- Environmentally friendly
- Minimal maintenance
- Quiet
- Sustainability



Fort Polk

- 4003 homes were retrofit with geothermal heat pumps
- Pumps were designed for heating, cooling, and hot water heating
- Electricity usage was reduced by 32.5% and natural gas usage was decreased by 100%
- Saved an estimated \$4.5 million since 1998





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